EFFECT OF COWDUNG AND POULTRY LITTER ON THE GROWTH AND YIELD OF OKRA (*Abelmoschus esculentus*)

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BY

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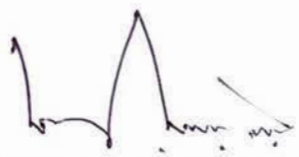

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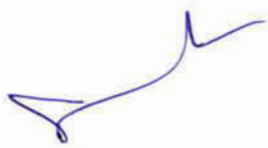

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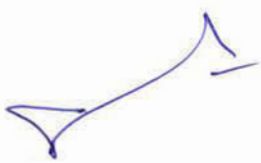

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This is to certify that the thesis entitled, "EFFECT OF COWDUNG AND POULTRY LITTER ON THE GROWTH AND YIELD OF OKRA" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in HORTICULTURE**, embodies the result of a piece of bona fide research work carried out by **MD. SHAHNAWAZ**, Registration No. 27451/00657 under my supervision and my guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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(Professor. A.K.M. Mahtab Uddin)
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Dedicated to

My

Beloved Parents

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December, 2007 *The Author*

EFFECT OF COWDUNG AND POULTRY LITTER ON THE GROWTH AND YIELD OF OKRA (*Abelmoschus esculentus*)

ABSTRACT

An experiment was conducted to evaluate the effect of cowdung and poultry litter on the growth and yield of okra at the central farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from April to July, 2007. The experiment was conducted with two factors, factor A: cowdung with different levels (C_0= no manure,C_1= 9 t/ha,C_2= 10 t/ha,C_3= 11 t/ha) and factor B: poultry litter with different levels (P_o= no manure,P_1= 7 t/ha,P_2=8 t/ha,P_3= 9 t/ha). The two factors experiment was laid out in Randomized Complete Block Design (RCBD). The result of the experiment revealed that plant height, number of leaves per plant, leaf length, leaf breadth, petiole length, pod length, pod weight, number of pod per plant, pod yield per plant, pod yield per plot, pod yield per hectare were significantly influenced by the different levels of cowdung and poultry litter. The highest level of cowdung (11 ton/ha) produced the highest plant height (71.66 cm.), number of leaves (17.71), leaf length (18.70 cm.), leaf breadth (25.54 cm.), green pod yield/plot (2.98 kg), pod yield/ha (8.30 ton) while the lowest green pod yield/pot (1.98 kg), pod yield/ha (5.51 ton) were produced from control treatment. The highest level of poultry litter (9 ton/ha) gave the highest plant height (61.73 cm.), number of leaves (16.54), leaf length (17.14 cm.), leaf breadth (22.13cm.), green pod yield/plot (2.62 kg), pod yield/ha (7.30 ton) and the lowest green pod yield/pot (2.18 kg), pod yield/ha (6.18 ton) were produced from control treatment. The combined effect of different levels of cowdung and poultry litter also found significant. The maximum plant height (76.88 cm.), number of leaves (18.16), leaf length (19.52 cm.), leaf breadth (26.48 cm.), pod yield/plot (3.24 kg), pod yield/ha (9 ton) was obtained from the treatment combination of C_3P_3 (application of 11 t/ha cowdung with 9 t/ha poultry litter). The lowest pod yield/ha (5 ton) was recorded from C_0P_0 (where cowdung and poultry litter were not applied).

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ABBREVIATIONS

FULL WORD	ABBREVIATION
Agro-Ecological Zone	AEZ
Bangladesh Agricultural Research Institute	BARI
Bangladesh Bureau of Statistics	BBS
Days After Sowing	DAS
and others	*et al.*
Etcetra	Etc
Least Significant Difference	LSD
Non Significant	NS
Randomized Complete Block Design	RCBD
Sher-e-Bangla Agricultural University	SAU

CHAPTER I

INTRODUCTION

Okra (*Abelmoschus esculentus* L.) is a member under Malvaceae family and is also known as Lady's finger and Okra. It is an annual vegetable crop grown from seed in tropical and sub-tropical parts of the world (Thakur and Arora, 1986).). It is well distributed throughout the Indian sub-continent and East Asia (Rashid, 1990). Its tender green fruits are popular as vegetable among all classes of people in Bangladesh and elsewhere in the world.

Okra is a nutritious and delicious vegetable, fairly rich in vitamins and minerals. Per 100 gm of edible portion of pod has moderate levels of vitamin A (0.01 mg) and C (18 g), calcium (90 mg), phosphorus and potassium. The content of thiamine (0.07 mg), riboflavin (0.08 mg) and niacin (0.08 mg) per 100 g edible portion of pod is higher than that of many vegetables (Rashid, 1990). Tender pods have high mucilage content and are used in soups and gravies. The pods also have some medicinal value and a mucilaginous preparation from the pod can be used as a plasma replacement or blood volume expander.

In Bangladesh vegetable production is not uniform round the year. Vegetables are plenty in winter, but are lower in summer. The total vegetable production, around 30% is produced during kharif season (April to September). and 70% is produced in Rabi season (October to March) (Anon., 1993). Though it is popular in the country, its production is mainly concentrated during summer. So, as vegetable okra can get an importance in summer. Total production of okra is about 19210 metric tones produced from 6210.53 hectare of land in the year 2003, and the average yield is about 3.093 t/ha (BBS, 2004), which is very low, compared to that of other developed countries where the yield is as high as 7.0-12.0 t/ha (Yamaguchi, 1998).

Growth and yield of okra depend on nutrient availability in soil, which is related to the judicious application of manures and fertilizers. Nutrient may be applied through two sources viz. organic and inorganic. Increased use of inorganic fertilizer in crop production causes health hazards, creates problem to the environment including the pollution of air, water and soil etc. The continuous use of chemical fertilizer badly affects the soil texture, structure, color, aeration, water holding capacity and microbial activity of soil. A good soil has an organic matter content of more than 3%. But in Bangladesh soil of most region have less than 1.5%, some soil have less than 1% organic matter. For continuous cropping, organic manures applied to the crop fields through cowdung, poultry litter, farmyard manure etc. are insufficient. Now a days, gradual deficiency in soil organic matter and reduce yield of crops are alarming factors and burning issues for the farmers and agriculturists. All efford should be made to develop consciousness of the farmers about the importance of soil organic matter in the long term maintainance of soil productivity. In recent year poultry and livestock farming are increasing. So manure like poultry litter, cowdung etc. are becoming available.

Different manures contain different amount of nutrient in different proportion and their mode of nutrient release is not same. So, different manures may influence the growth, yield in different angles.

Considering the above facts, the present research was under taken with the following objectives:

- To study the effect of cowdung as organic source of nutrient on the growth and yield of okra.
- To determine the effect of poultry litter as organic source of nutrient on the growth and yield of okra.
- To find out the optimum level of cowdung and poultry litter for better growth and yield of okra.

CHAPTER II

REVIEW OF LITERATURE

Okra is one of the most important vegetables in Bangladesh, as well as in the world. Researches on various aspects of its production technology have been carried out worldwide. Among these researches, very few numbers of works were reported where the effect of cowdung and poultry manure was studied. However, some of the researches and their findings related to the present study carried out at home and abroad are reviewed in this chapter under the following headings.

Effect of Cowdung and Poultry litter on the growth and yield of okra:

The organic matter is called the life of the soil. Fertility of particular soil is determined by the presence of organic matter. The organic matter contents of soil vary from 0-5% and it depends on several factors like origin of soil, climatic conditions, vegetation, microbial activities etc. The physical, chemical and biological properties of soil are greatly influenced by organic matter. Although, organic matter contain all the essential plant nutrients, but after application of organic manures required time to convert its available form to the plant. That is why the response of crops to organic manure is low. But due to the residual and beneficial effects on soil properties, applications of organic manures are encouraged. Some available information about the effects of organic manures on growth and yield of okra are reviewed here.

Wright (1960) studied that Horse and Cow manure contains approximately 0.5% N, 0.55% K and 0.25 % Phosphoric acid. It thus supplies three of main elements needed by fruit plants.

Yawalkar *et al.* (1962), who recommended 8 tones of farm yard manure, 45 kg N, 22 kg each of P and K per hectare for the production of 2725 kg green fruits.

Dumitrescu (1960) from his experiment on "Composts as organic manures of high fertilizing value" reported that application of poultry manure at the rate of 20 t/ha gave higher total yield.

Palevich (1965) observed that nitrogenous fertilizer and organic manure improved total yield, weight per fruit, size of fruit and height of plants. He also reported that cowdung manure application in addition to N and P fertilizers significantly increased yield by 14-41 % in comparison with plots that received the same amount of N and P but without manure.

Kamaluddin (1968) reported that organic manure increases soil organic matter and essential nutrient elements for plants.

Under coimbatore conditions, Kamalanathan *et al.* (1970) recommended 40 kg N and 30 kg K per hectare along with 25 tones of farmyard manure at the time of soil preparation.

In Rajasthan, at Udaipur, Verma *et al.* (1970) recommended the application of 90 kg N and 80 kg P and 10 tones of farmyard manure per hectare during kharif season for improving the qualitative and quantitative yield of okra.

Gaur *et al.* (1971) found that FYM and organic residues were effective in increasing the level of organic matter even under tropical conditions.

Edmond *et al.* (1977) reported that organic matter increased the pore space of the soil and thus improved the rate of gas exchange. Application of compost to the soil increased water-holding capacity, reduced soil erosion and improved

the physio-chemical and biological condition of the soil besides providing with plant nutrients.

Cheung and Wong (1983) carried out an experiment on animal manures and sewage sludges for growing vegetables and stated that chicken manure and pig manure resulted in better growth than sewage sludges.

Farid *et al.* (1998) conducted an experiment at Joydebpur to study the efficiency of poultry manure and cowdung alone and in combination with mineral fertilizers on the yield of cabbage(var. Atlas-70).They mentioned that the head yield was increased both by cowdung and poultry manure with macro and micro nutrients added to the treatments. But the increase due to poultry manure was always higher than that of cowdung. Poultry manure alone increased the yield significantly when it was applied at the rate of 20 t/ha.

Kabir (1998) carried out an experiment at the Horticultural Farm, Bangladesh Agricultural University, Mymensingh to find out the effect of poultry manure and cowdung in presence and absence of chemical fertilizer on growth and yield of cabbage and reported that combination of poultry drops and inorganic fertilizer performed the best.

Hochmuth *et al.* (1993) conducted an experiment to investigate the response of cabbage yield, head quality and leaf nutrient status to poultry manure fertilization. They reported that the marketable yield of cabbage responded quadratically to increasing rates of poultry manure during 1990,with the maximum yield (28.4 t/ha) being obtained by 18.8 t/ha. Yield recorded with 1.0 to 1.4 of conventional NPK fertilizer/ha were same as those with the highest rate of manure. The result showed that manuring efficiency was initially higher with commercial fertilizer than the poultry manure alone.

Krupkin *et al.* (1994) made an investigation using poultry manure, mixture of poultry manure plus hydrolysis lignin, and a compost of poultry manure plus hydrolysis lignin as organic fertilizers for potatoes, carrots, cabbage etc. with and without irrigation .The result showed that these organic fertilizers improved the yield and quality of the crops, especially on soil having a low content of nitrate N, but had only little effect on soils well supplied with nitrate N.

Flynn *et al.* (1995) carried out an experiment to evaluate the suitability of composted broiler chicken manure as a potting substrate using lettuce plants. They mentioned that the broiler manure containing peanut hulls as breeding materials was composted and then combined with a commercially available potting substrate. Highest fresh weight yield was obtained when broiler chicken litter compost was mixed with commercially available potting substrate at 3:1 ratio. There was no evidence of physiological disorders resulting from excessive nutrient concentration.

An experiment was carried out by Zarate *et al.* (1997) in Brazil to evaluate the rates and methods of application of poultry manures on lettuce. The soil was supplied with 0,7 or 14 t semi-rotted poultry manure incorporated into the soil and 0,7 or 14 t semi-rotted poultry manure applied to the soil surface. They found in the absence on incorporated manure, surface application of 14 t manure/ha gave significantly higher yield(17.8 t fresh matter/ha) than other nutrients. When 7 t/ha was incorporated, the rate of surface application had no significant effect on yields(13.3-17 t/ha),where as when 14 t/ha was incorporated, surface application of 7 t/ha manure gave the significantly highest yields (20 t/ha fresh matter)

Prezotti *et al.* (1988) suggested that organic manure applications increased total productivity by 48% and improved the proportion of large fruits in the total yield.

Rue (1998) carried out an experiment by using compost, obtained from dairy manure and municipal solid waste to find out the beneficial effects on broccoli. He found beneficial effects on growth, yield and nutrient component with compost application in the broccoli production.

Naidu *et al.* (1999) conducted a study on a medium black soil at the Maharajpur vegetable research farm in Mabalpur, Madhya Pradesh, India during spring-summer seasons of 1996-97, 1997-98 and 1998-99 to evaluate the effect of manures, bio- and chemical fertilizers on the soil microbial population and growth and yield of okra. The treatments used in the experiment were: (T_1) control; (T_2) NPK (80:60:50)+20 tones farmyard manure (FYM)/ha; (T_3) 55 kg N+35 kg $P_2 0_5$+25 tones FYM/ha; (T_4) 25 kg $P_2 0_5$+70 kg $K_2 0$+9 tones poultry manure; (T_5) 10 kg $P_2 0_5$+3 tones vermicompost /ha; (T_6) 12 $K_2 0$+20 tones FYM+4 tones poultry manure/ha; (T_7) 20 tones FYM+14 tones vermicompost/ha; (T_8) 90 kg $K_2 0$+7.5 tones poultry manure+1.0 tonne vermicornpost/ha; (T_9) 35 tones FYM + *Azospirillum* + phosphorus solubilizing bacterium (PSB); (T_{10}) 10 tones poultry manure/ha + *Azospirillum* +PSB; (T_{11}) 3 tones vermicompost + Azospirillum +PSB; and (T_{12}) Azospirillum+PSB. Results showed that plant height, number of leaves per plant, number of nodes per plant, internodal length, number of fruits per plant, weight of fruits per plant and fruit yield were maximum under T_2. On the other hand, crude protein percentage was highest Linder T_8. The maximum net income of Rs. 19089 along with a 0.02 benefit: cost ratio was obtained under T_2.

Patil *et al.* (2000) conducted an experiment to develop a composite technique to produce quality okra pods for export purposes by using organic manures, biofertilizers and biopesticides. The three highest pod yields (128.59, 125.42 and 125.17 q/ha) were recorded from 75 kg N/ha + biofertilizer + FYM, 50 kg N/ha + biofertilizer + FYM and 75 kg N/ha + FYM, respectively. Although crops sown at the 30 x 15 cm spacing recorded the highest yield (118.23 q/ha),

the 30 x 30 cm spacing resulted in comparable yields (117.13 q/ha). The application of biofertilizer (1 litre slurry) + FYM + 50 kg N/ha was beneficial for obtaining higher yields (128.59 q/ha) of export quality pods (5-7 cm in length) when harvested on alternate days, compared to their individual application.

Bandyopadhyay (2001) conducted an experiment to evaluate the effect of polythene and organic mulching under different levels of manuring practices of growth and yield of okra. Okra cv. Parbhani Kranti plants were subjected to different mulching (using green leaves of Antigonon leptopus or polyethylene sheets) and fertilizer treatments (oilseed cake and/or NPK at 25:25:25 or 50:25:25) in a field experiment conducted in India during the kharif season. The highest pod yield (171.92 q/ha), cost:benefit ratio (4.86) and growth attributing characters were observed with 10 t FYM/ha + 50:25:25 kg NPK/ha under the green leaves of A. leptopus. In general, green leaf mulching was better and cheaper than polythene mulching.

Raj and Kumari (2001) reported that the effect of farmyard manure (FYM; 12 t/ha) and Azospirillum Inoculation (1kg/ha), singly or In combination (1:1) with other organic amendmcnts (neem cake, green leaf, and enriched compost), on the yield and quality of okra cv. Arka Anamika, was studied in Vellayani, Kerala, India, from January to May 1998. All treatments were applied as basal dressing. All organic manures except FYM alone were superior to the control (recommended fertilizer of 12 t FYM/ha+50:8:25 N:P:K kg/ha) with respect to yield.

Bhadoria *et al.* (2002) conducted field experiments in 1997-98 and 1998-99, in Kharagpur, West Bengal, India to investigate the effect of organic manure in improving the quality of rice (autumn crop) and okra (spring crop). Treatments consisted of: farmyard manure (FYM); FYM + microbial culture (FYM + MC); chemical fertilizers (CF); processed city waste (PCW); oil cake pellets (OCP); and vermicompost (VC). Among the different treatments, FYM produced the

best rice cooking and milling quality, and the best okra nutritional quality. The protein content and total minerals of okra fruit increased under the FYM treatment.

Ferreira *et al.* (2002) reported that the use of organic and mineral fertilizer for production of okra was evaluated in northern Rio de Janeiro, Brazil, 1998-99. Doses of 0, 10, 20, 30, and 40 t manure/ha were applied with or without NPK fertilizer. A significant increase in yield with mineral fertilizer was observed during both years. A significant increase in yield was also obtained with increase in manure.

Singh *et al.* (2004) studied that the integrated use of organic and inorganic sources of nutrients and biofertilizers increased the N, P and K concentrations in the plants (including fruits) of okra, pea and tomato. The integrated nutrient management also significantly increased shoot dry matter yield of tomato and fruit yields of okra and tomato.

CHAPTER III

MATERIALS AND METHODS

3.1 Experimental site

The experiment was conducted at the Central Farm of the Sher-e-Bangla Agricultural University, Dhaka during the period from April to July 2007. The site was located in 90.2^{O}N and 23.5^{0}E latitude. The altitude of the location was 8.2 m from the sea level (The Meteorological Department of Bangladesh, Agargaon , Dhaka-1207).

3.2 Climate

The experimental area was under the sub-tropical climatic zone which was characterized by heavy rainfall during Kharif season (April to September) and scanty in the Rabi season (October to March). There was no rainfall during the month of December, January and February. The average maximum temperature during the period of experiment was 33.03˚C and the average minimum temperature was 25.18˚C. Details of the meteorological data in respect of temperature, rainfall and relative humidity during the period of the experiment were collected from the Meteorological Department of Bangladesh, Agargaon , Dhaka-1207 (Appendix I).

3.3 Soil

The experimental site was located in the Modhupur Tract (AEZ-28) and it was a high land with adequate irrigation facilities. The soil texture was silty clay with a pH 5.6. Soil samples of the experimental plot was collected from a depth of 0 to 30 cm before conducting the experiment. Soil analyzed in the Soil Resources Development Institute (SRDI) Farmgate, Dhaka. have been presented in (Appendix II).

3.4 Planting materials used in the experiment

The okra variety used in the experiment was **"BARI Dherosh 1"** which is resistant to yellow vein mosaic virus, a severe disease of okra. The crop is a

high yielding variety developed by the Vegetable Division of Horticulture Research Center, Bangladesh Agricultural Research Institute (BARI) and released for commercial cultivation in 1996 (BARI,2004).The seeds were collected from the Horticulture Research Center, Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur.

3.5 Design of the experiment

The field experiment was conducted by Randomized Complete Block Design (RCBD) with three replication. Two factors were used in the experiment viz. four levels of cowdung and four levels of poultry litter.

Factor-A: Four levels of cowdung

C_0: Control (No cowdung application)

C_1: 9 ton /ha (contain 90 kg N, 45 kg P and 99 kg K)

C_2: 10 ton /ha (contain 100 kg N, 50 kg P and 110 kg K)

C_3: 11 ton /ha (contain 110 kg N, 55 kg P and 121 kg K)

Factor-B: Four levels of Poultry litter

P_0: Control (No poultry litter application)

P_1: 7 ton /ha (contain 77 kg N, 35 kg P and 91 kg K)

P_2: 8 ton /ha (contain 88 kg N, 40 kg P and 104 kg K)

P_3: 9 ton /ha (contain 99 kg N, 45 kg P and 117 kg K)

Total 16 treatment combinations were as follows:

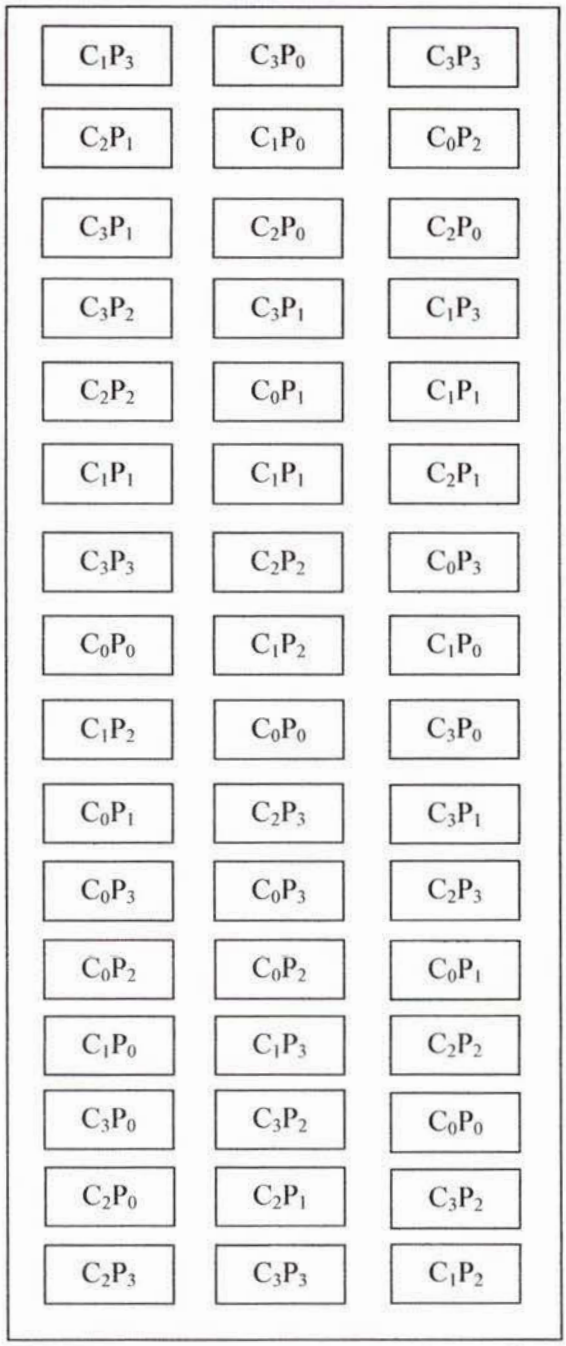
C_0P_0	C_0P_1	C_0P_2	C_0P_3	C_1P_0	C_1P_1	C_1P_2	C_1P_3
C_2P_0	C_2P_1	C_2P_2	C_2P_3	C_3P_0	C_3P_1	C_3P_2	C_3P_3

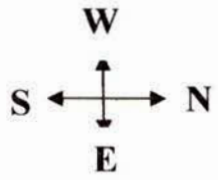
3.6 Layout of the experiment

The whole field was divided into three blocks and each block consisted of 16 plots. Thus the total numbers of plots were 48. The size of unit plot was $3.6m^2$

(3m×1.2m). A distance of 0.5 m between the plots and 1.0 m between the blocks were kept. The treatment was randomly assigned to each of the block. Each unit plot had 2 rows and each with 6 plants. Each plot contains 12 plants. Plant to plant distance was 50 cm and row to row distance was 60 cm.

Layout of the experiment has been shown in Figure





Plot size : 3 m × 1.2 m
Spacing: 60 cm × 50 cm

Plot spacing: 50 cm

Between block: 1m

Factor A: Cowdung

C_0 = Control
C_1 = 9 ton /ha
C_2 = 10 ton /ha
C_3 = 11 ton /ha

Factor B: Poultry litter

P_0 = Control
P_1 = 7 ton /ha
P_2 = 8 ton /ha
P_3 = 9 ton /ha

Figure 1. Field layout of the experiment in the Randomized Complete Block Design (RCBD)

3.7 Land preparation

The land which was selected to conduct for the experiments was opened on 12th April, 2007 by a disc plough to open direct sunshine to kill soil born pathogens and soil inhabitants insects. The land was ploughed and cross-ploughed with a power tiller followed by laddering to break up the soil clods to obtain unit good tilth and to level the land. The weeds, crop residues and stables were removed from the field. After final land preparation the experimental plot was laid out, and the edge around each unit plot was raised to check run out of the nutrients.

3.8 Application of manures

The doses of organic manures were fixed in such a way that the total available N,P and K were almost same as suggested by Rashid (1990). Rashid suggested Cowdung 10 t/ha, Urea 150 kg/ha, TSP 100 kg/ha and MP 150 kg/ha which release 169 kg N, 70 kg P and 185 kg K (Cowdung contain 1%N, 0.5%P and 1.1%K). For this, cowdung 9 t/ha (contain 90 kg N, 45 kg P and 99 kg K) and poultry litter 7 t/ha (contain 77 kg N, 35 kg P and 91 kg K) were used in the experiment and combinedly they release 167 kg N, 80 kg P and 190 kg K which were near about same in amount as Rashid suggestion. All type of manures were applied during final land preparation as basal dose.

Nutrient status in Cowdung and Poultry litter was as follows

	% N	% P	% K
Cowdung	1	0.5	1.1
Poultry litter	1.1	0.5	1.3

Source: SRDI

3.9 Sowing of seeds

The okra seeds of cv. BARI Dherosh I were sown on 15th April, 2007 in rows of raised beds. Row to Row and plant to plant spacing were maintained 60 cm and 50 cm respectively. Three seeds were sown in each location. Then the seeds were covered with fine soil by hand and the field was irrigated lightly immediate after sowing.

3.10 Intercultural operations

The seedlings were kept under close observation and necessary intercultural operations were done through the cropping season for proper growth and development of the plant.

Gap filing

Dead, injured and weak seedlings were replaced by new vigour seedling from the stock kept on the border line of the experiment.

Weeding

Significant number of weed were found and weeding was done three times in these plots where it was necessary.

Thinning

Five to six days after germination only healthy seedling was kept to grow in each location and other seedling were removed.

Irrigation

A week after Sowing the requrement of irrigation was envisaged through visual estimation. Wherever the plants of a plot had shown the symptoms of wilting the plots were irrigated on the same day with a hosepipe until the entire plot was properly wet.

Drainage

Stagnant water was effectively drained out at the time of heavy rain.

Plant protection measure

For controlling shoot and pod borer mechanical control was adopted (hand picking). For controlling yellow vein virus plant was uprooted and destroyed by fire as soon as the symptom found in the field.

3.11 Harvesting

Green pods were harvested at 2 day interval when they attained edible stage (i.e. the tender young pods of 8-13 cm long). Green pod harvesting was started from 4, June and was continued up to 20 July.

3.12 Collection of data

Data were recorded from each plot on the following parameters from the sample plants during experiment. Ten (10) plants were randomly selected from each unit plot for the collection of per plant data.

Plant height (cm)

Plant height was measured from the base to the tip of the longest leaf at 15, 30 and 45 days after sowing (DAS). A meter scale was used to measure the plant height and expressed in cm.

Number of leaves per plant

Number of leaves per plant of ten randomly selected plans was counted at 15, 30 and 45 days after sowing (DAS). The smallest young leaves at the growing point of the plant were excluded from counting. Calculating the average number of leaves, the average number was recorded.

Leaf length (cm)

Leaves of ten (10) randomly selected plants were made detached and measured in centimeter (cm) by a meter scale at 15, 30 and 45 days after sowing (DAS).

Leaf breadth (cm)

Leaves of selected plants were detached and leaf diameter was taken from one margin to another margin of the leaf and measured in centimeter (cm) by a meter scale at 15, 30 and 45 days after sowing (DAS).

Petiole length (cm)

Petiole length was measured in centimeter (cm) by a meter scale at 15, 30 and 45 days after sowing (DAS) from the point of attachment of the leaf.

Green pod length (cm)

Ten randomly selected pods from each plot were taken and length was recorded by a meter scale in cm and finally mean was calculated.

Green pod diameter (cm)

Mean diameter of 10 randomly selected pods from each plot were measured in cm with the help of slide calipers.

Number of green pods per plant

Mean number of green pods of selected plants from each plot was recorded.

Weight of individual green pod (gm)

Weight of individual green pod collected from the selected plants was measured in gram (g) with the help of an electrical balance.

Green pod yield per plant (gm)

Weight of total green pod collected from each selected plant was measured in gram (gm) with the help of an electrical balance.

Green pod yield per plot (kg)

Mean weight of edible green pods of 10 plants from each plot was measured in kilogram (kg).

Green pod yield per hectare (t)

Green pod yield per hectare was calculated in ton by converting the mean green pod yield per plot.

3.13 Statistical analysis

The collected data on various parameters were statistically analyzed using MSTATC package program. The mean for all the treatment was calculated and analyses of variances of all the characters were performed by F-variance test. The significant of difference between the pairs of treatment means was evaluated by the Least Significant Difference (LSD) test at 5% and at 1% levels of probability (Gomez and Gomez, 1984).

CHAPTER IV

RESULTS AND DISCUSSION

The experiment was conducted to observe the effect of organic sources of nutrient (Cowdung and Poultry manure) on the growth and yield of okra. A summary of the analysis of variance of all the characteristics studied with their sources of variance and corresponding degrees of freedom have been shown in appendix iii. Data on different parameters were analyzed statistically and the result has been presented in tables, graphs and figures. The results of the present study have been presented and discussed and possible interpretations have been made under the following headings.

4.1 Plant height

Application of cowdung exhibited a significant influence on the height of plant at 15, 30, and 45 DAS. Different levels of cowdung showed highly significant influence on plant height. At 15 DAS, the tallest plant height (14.66 cm) was obtained from C_3 (cowdung 11 t/ha) whereas the shortest plant height (6.46 cm) was obtained from control (no cowdung) treatment. At 30 DAS, the tallest plant height (41.99 cm) was obtained from C_3 and the shortest plant height (19.28 cm) was obtained from control (no cowdung) treatment. At 45 DAS, the tallest plant height (71.66 cm) was obtained from C_3 while the shortest plant height (40.72 cm) was obtained from control (no manure) treatment (Figure 2). It was revealed that plant height was increased with the increased of cowdung. This could be due to promote of nitrogen uptake which enhanced vegetative growth of okra plants.

Application of poultry litter showed highly significant influence on the height of plant at 15, 30, and 45 DAS. At 15 DAS, the highest plant height (11.35 cm) was obtained from P_3 and the shortest plant height (9.26 cm) was obtained from control (no manure) treatment. At 30 DAS, the highest plant height (34.55 cm)

was obtained from P_3 and the shortest height (27.05 cm) was found from control treatment and at 45 DAS, the highest height (61.73 cm) was obtained

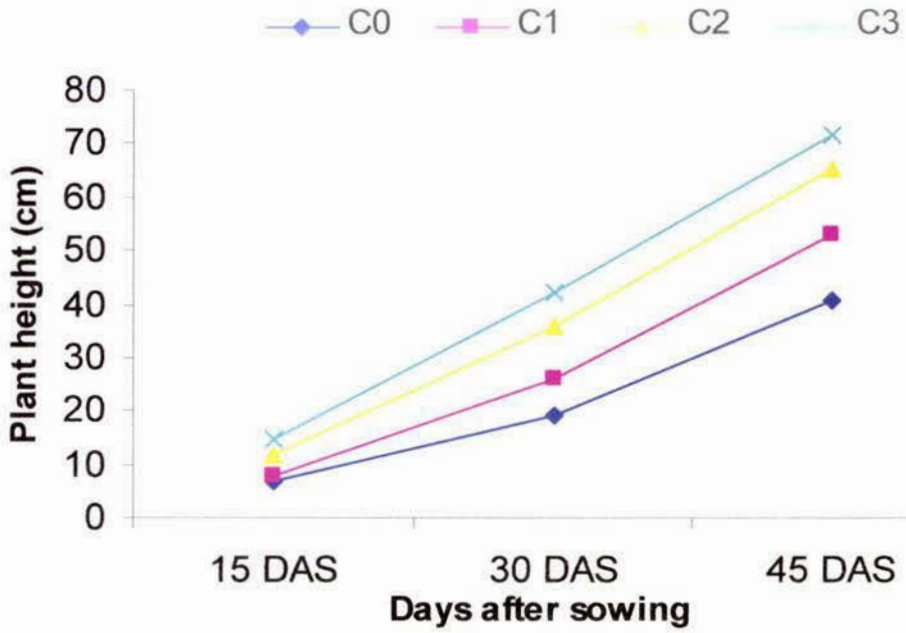


Figure 2. Effect of different levels of cowdung on the plant height of okra

C_0 = 0 t/ha, C_1 = 9 t/ha, C_2 = 10 t/ha, C_3 = 11 t/ha

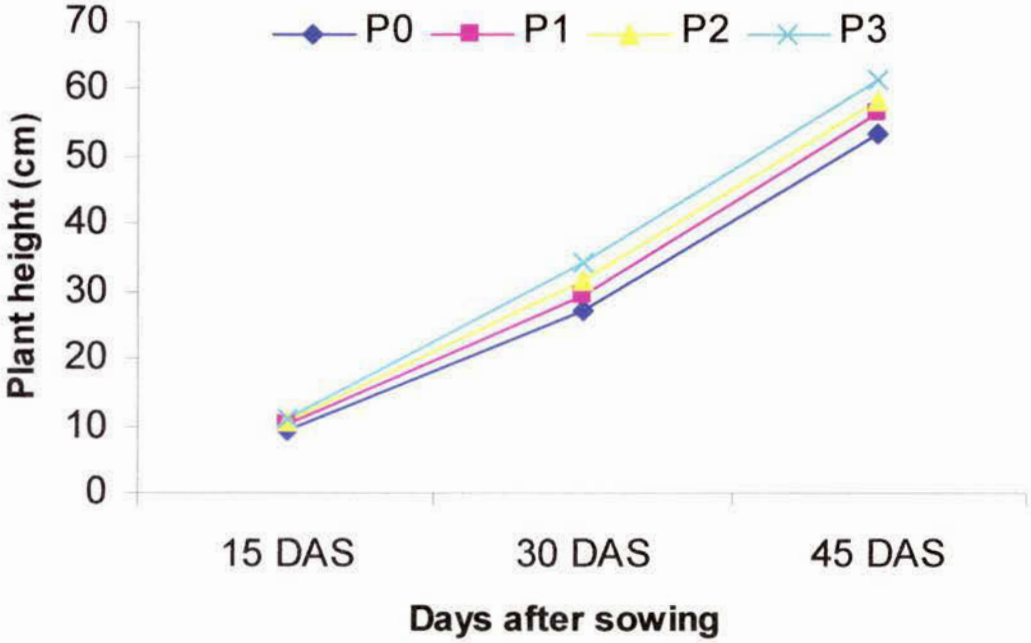


Figure 3. Effect of different levels of poultry litter on the plant height of okra

P_0 = 0 t/ha, P_1 = 7 t/ha, P_2 = 8 t/ha, P_3 = 9 t/ha

from P_3 where as the shortest height was (53.58 cm) was obtained from control treatment (Figure 3). With the increasing of poultry litter the plant height was also increased. This might be due to influence on nitrogen uptake which helped in vegetative growth.

The plant height was significantly influenced by the treatments of cowdung and poultry litter combination at 15, 30 and 40 DAS. At 15 DAS, the longest plant height (15.67cm) was obtained from C_3P_3 and the shortest height (6.47 cm) was recorded from control treatment. At 30 DAS, the longest plant height (47.46 cm) was obtained from C_3P_3 while the shortest plant height (16.68 cm) was found from control treatment. At 45 DAS, the longest plant height (76.88 cm) was obtained from C_3P_3 where as the shortest plant height (37.38 cm) was recorded from control treatment (Table 3). It was revealed that plant height increased with the increased in the application of cowdung and poultry litter. This result was due to increase of N, P and K concentration in the plant of okra. Thus manure improved plant height which was supported by Singh *et al.* (2004), Cheung and Wong (1983) and Palevich (1965).

4.2 Number of leaves per plant

Application of cowdung exhibited a significant influence on the number of leaves per plant at 15 DAS, 30 DAS and 45 DAS. At 15 DAS, the highest number of leaves (4.41) was recorded from C_3 and the lowest number of leaves (3.24) was recorded from control treatment. At 30 DAS, the highest number of leaves (10.94) was obtained from C_3 and the lowest number of leaves (8.66) was recorded from control treatment. At 45 DAS, the maximum number of leaves (17.71) was obtained from C_3 and the minimum number of leaves (14.09) was recorded from control treatment (Figure 4). It was revealed that the number of leaves per plant increased with the increased in cowdung application. This might be due to P, K concentration was increased with the increase of cowdung which has significant role in photosynthesis, storage energy, cell division and cell enlargement that enhanced the number of leaves.

Application of poultry litter showed highly significant influence on the number of leaves per plant at 15, 30, and 45 DAS. At 15 DAS, P_3 showed the maximum number of leaves (4.08) and control treatment showed the minimum number (3.69) of leaves. At 30 DAS, P_3 showed the maximum number of leaves (10.13) and control treatment showed the minimum number of (9.51) leaves. At 45 DAS, P_3 showed the maximum number of (16.54) leaves where as control treatment showed the minimum number (15.24) of leaves (Figure 5). There the number of leaves per plant was increased with the increase of poultry litter. This might be due to increase of nutrient concentration that influenced photosynthesis and cell expansion.

Interaction between cowdung and poultry litter showed significant influence on number of leaves per plant at 15, 30 and 40 DAS. At 15 DAS, the maximum the highest number of leaves (4.83) was obtained from C_3P_3 and the minimum the minimum number of leaves (3.01) was found from control treatment. At 30 DAS, the highest number of leaves (11.53) was obtained from C_3P_3 while the lowest number of leaves (8.16) was recorded from control treatment. At 45 DAS, the maximum number (18.16) of leaves per plant was obtained from C_3P_3 treatment and the minimum number was (12.63) was obtained from control treatment (Table 3). The result revealed that the number of leaves per plant differed significantly due to the application of different level of cowdung and poultry litter. Naidu *et al.* (1999) found the same result while conducted a study to evaluate the effect of manure.

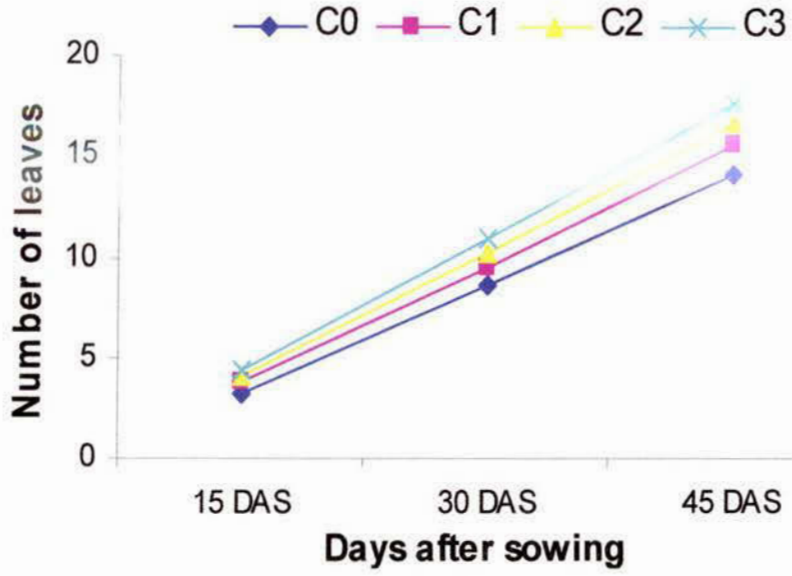


Figure 4. Effect of different levels of cowdung on the no. of leaves plant^{-1} of okra

C_0 = 0 t/ha, C_1 = 9 t/ha, C_2 = 10 t/ha, C_3 = 11 t/ha

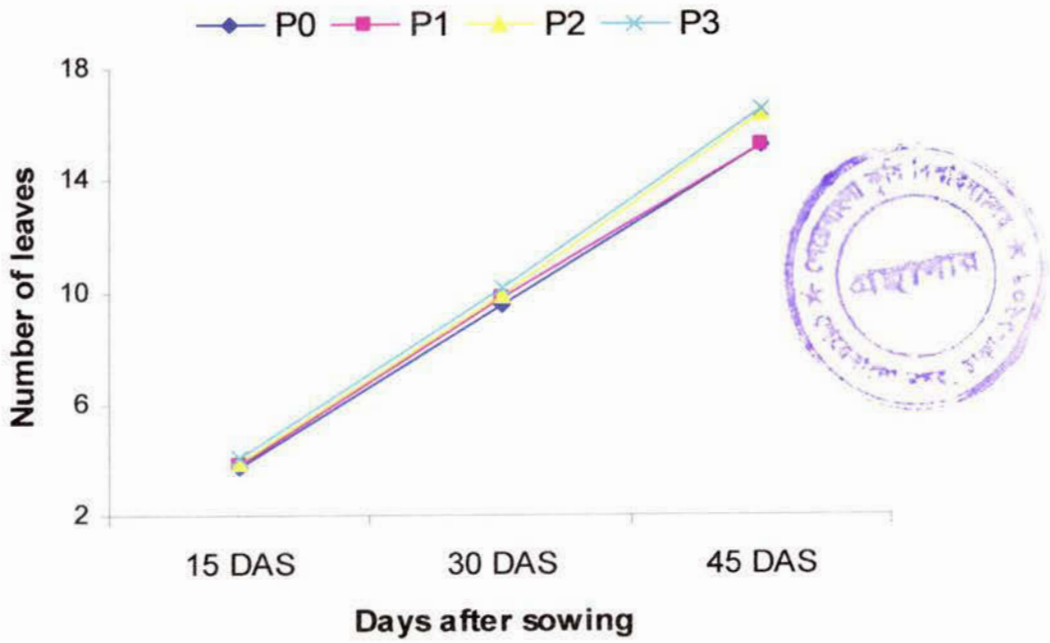


Figure 5. Effect of different levels of poultry litter on the no. of leaves plant^{-1} of okra

P_0 = 0 t/ha, P_1 = 7 t/ha, P_2 = 8 t/ha, P_3 = 9 t/ha

4.3 Leaf length

Cowdung had a significant influence on the length of leaves of okra plants at 15, 30 and 45 DAS. At 15 DAS, the longest leaf length (11.29 cm) was recorded from C_3 where as the shortest length (6.30 cm) was obtained from control treatment. At 30 DAS, the longest leaf length (16.25 cm) was recorded from C_3 while the shortest length (9.48 cm) was found from control treatment. At 45 DAS, the highest leaf length was recorded (18.70 cm) from C_3 treatment and the minimum length was recorded (12.74 cm) from control treatment (Table 1). It was revealed that leaf length was increased with the increased of cowdung. This might be due to increase in nitrogen concentration which stimulated leaf length.

There had a significant influence of poultry litter on okra plant in respect of leaf length at 15, 30 and 45 DAS. At 15 DAS, the longest leaf length (9.83 cm) was recorded from P_3 and the shortest length (8.50 cm) was recorded from control treatment. At 30 DAS, the longest leaf length (14.13 cm) was recorded from P_3 where as the shortest length (12.20 cm) was recorded from control treatment. At 45 DAS, the highest leaf length (17.14 cm) was obtained from P_3 treatment and the lowest length (15.39 cm) was obtained from control treatment (Table 2). It was found that leaf length was increased with the increased of poultry litter. This might be due to increase in nitrogen concentration which stimulated leaf length.

Cowdung and poultry litter combinedly performed significant effect on the leaf length of okra plant at 15, 30 and 45 DAS. The longest leaf length was found with increasing of level of cowdung and Poultry litter. At 15 DAS, the longest leaf length (12.21 cm) was recorded from C_3P_3 where as the shortest length (5.65 cm) was obtained from control treatment. At 30 DAS, the longest leaf length (16.95 cm) was recorded from C_3P_3 while the shortest length (8.46 cm) was recorded from control treatment. At 45 DAS, the longest leaf length (19.52 cm) was recorded from C_3P_3 treatment and the shortest length (11.61 cm) was

recorded from control treatment (Table 3). This result was found due to nutrient concentration in plants. Kamaluddin (1968), Edmond *et al.* (1977) stated that organic manure increase plant nutrient.

4.4 Leaf Breadth

Statistically significant result was observed on leaf breadth from different level of cowdung at 15, 30 and 45 DAS. At 15 DAS, the widest leaf (16.11 cm) was obtained from C_3 and the narrowest leaf (9.18 cm) was obtained from control treatment. At 30 DAS, the widest leaf (22.03 cm) was obtained from C_3 and the narrowest leaf (11.90 cm) was recorded from control. At 45 DAS, the widest leaf (25.54 cm) was found from C_3 and the narrowest leaf (15.47 cm) was obtained from control treatment (Table 1).

Poultry litter showed significant effect on leaf breadth with its different level at 15, 30 and 45 DAS. At 15 DAS, the widest leaf (14 cm) was obtained from P_3 and the narrowest leaf (12.15 cm) was found from control treatment. At 30 DAS, the widest leaf (18.84 cm) was recorded from P_3 and the narrowest leaf (15.95 cm) was obtained from control treatment. At 45 DAS, the widest leaf (22.13 cm) was recorded from P_3 and the narrowest leaf (19.49 cm) was obtained from control treatment (Table 2).

The combined effect of cowdung and poultry litter showed significant variation on leaf breadth at 15, 30 and 45 DAS which was increased with the increasing level of application. At 15 DAS, the maximum leaf breadth (17.13 cm) was obtained from C_3P_3 where as the minimum leaf breadth (8.15 cm) was recorded from control treatment. At 30 DAS, the maximum leaf breadth (23.39 cm) was obtained from C_3P_3 while the minimum leaf breadth (10.38 cm) was found from control treatment (Table 3). At 45 DAS, the maximum leaf breadth (26.48 cm) was obtained from C_3P_3 and the minimum leaf breadth (14.23 cm) was recorded from control treatment (Table 3).

Table 1: Effect of Cowdung on leaf length, leaf breadth and petiole length.

Treatment	Leaf length (cm.)			Leaf breadth (cm.)			Petiole length (cm.)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
C_0	6.30	9.48	12.74	9.18	11.90	15.47	3.37	4.62	5.66
C_1	8.85	12.40	15.88	12.41	16.12	19.16	4.54	6.45	7.35
C_2	10.15	14.59	17.49	14.51	19.32	22.76	6.26	8.10	8.90
C_3	11.29	16.25	18.70	16.11	22.03	25.54	7.38	10.25	11.29
LSD(0.05)	0.99	1.13	1.26	1.38	2.34	1.64	0.68	0.90	1.01
LSD(0.01)	1.34	1.52	1.69	1.85	3.15	2.21	0.91	1.22	1.35
Level of significance	**	**	**	**	**	**	**	**	**
CV (%)	6.51	5.14	4.64	6.33	8.09	4.75	7.54	7.37	7.26

NS = Not Significant
* = Significant at 5% level of probability
** = Significant at 1% level of probability

Table 2: Effect of Poultry litter on leaf length, leaf breadth and petiole length.

Treatment	Leaf length (cm.)			Leaf breadth (cm.)			Petiole length (cm.)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
P_0	8.50	12.20	15.39	12.15	15.95	19.49	4.82	7.06	8.05
P_1	8.96	12.91	15.92	12.82	16.83	20.24	5.29	6.98	7.71
P_2	9.30	13.47	16.37	13.25	17.74	21.07	5.21	7.36	8.69
P_3	9.83	14.13	17.14	14.00	18.84	22.13	6.22	8.02	9.25
LSD(0.05)	0.99	1.13	1.26	1.38	2.34	1.64	0.68	0.90	1.01
LSD(0.01)	1.34	1.52	1.69	1.85	3.15	2.21	0.91	1.22	1.35
Level of significance	*	**	*	*	*	**	**	*	*
CV (%)	6.51	5.14	4.64	6.33	8.09	4.75	7.54	7.37	7.26

NS = Not Significant
* = Significant at 5% level of probability
** = Significant at 1% level of probability

Table 3: Combined effect of Cowdung and Poultry litter on the growth of Okra.

Treatment	Plant height(cm.)			No. of leaves			Leaf length (cm.)			Leaf breadth (cm.)			Petiole length (cm.)		
	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
C_0P_0	6.47	16.68	37.38	3.01	8.16	12.63	5.65	8.46	11.61	8.15	10.38	14.23	3.08	4.67	5.46
C_0P_1	6.70	19.65	38.60	3.21	8.58	13.83	6.11	9.20	12.40	9.31	11.36	15.19	3.05	4.33	4.83
C_0P_2	7.26	19.90	41.95	3.43	8.80	14.86	6.37	9.66	12.95	9.00	12.23	15.58	3.27	4.19	5.56
C_0P_3	7.33	20.90	44.98	3.30	9.10	15.03	7.06	10.61	14.01	10.24	13.64	16.89	4.06	5.28	6.80
C_1P_0	6.50	21.93	48.98	3.57	9.10	15.26	8.06	11.09	14.81	11.37	14.19	17.85	4.18	6.16	7.19
C_1P_1	8.23	25.73	50.98	3.94	9.80	15.86	8.70	11.92	15.50	12.04	15.03	18.34	4.58	5.53	6.43
C_1P_2	8.41	27.66	54.08	3.87	9.40	15.43	9.26	13.05	16.26	13.07	17.22	19.52	4.51	7.12	8.00
C_1P_3	9.08	28.25	57.48	4.06	9.66	15.90	9.39	13.55	16.94	13.16	18.04	20.93	4.88	6.98	7.77
C_2P_0	10.25	31.30	61.58	4.00	10.23	15.98	9.54	13.73	17.00	13.56	17.85	20.57	5.60	7.13	8.04
C_2P_1	10.67	32.90	65.66	3.90	10.20	16.48	10.07	14.38	17.30	14.16	19.50	22.70	6.43	8.25	8.59
C_2P_2	11.98	37.16	65.66	4.10	10.06	17.00	10.34	14.82	17.59	14.87	19.62	23.51	5.44	8.42	9.32
C_2P_3	13.30	41.60	67.58	4.10	10.23	17.06	10.65	15.42	18.08	15.46	20.32	24.24	7.58	8.61	9.63
C_3P_0	13.80	38.30	66.38	4.17	10.53	17.10	10.76	15.55	18.13	15.50	21.40	25.29	6.41	10.29	11.48
C_3P_1	14.66	39.93	71.11	4.30	10.51	17.58	10.95	16.15	18.51	15.74	21.44	24.72	7.11	9.80	10.99
C_3P_2	14.49	42.23	72.30	4.33	11.18	18.01	11.22	16.35	18.67	16.07	21.89	25.65	7.63	9.68	11.06
C_3P_3	15.67	47.46	76.88	4.83	11.53	18.16	12.21	16.95	19.52	17.13	23.39	26.48	8.63	11.20	11.61
LSD(0.05)	1.14	1.92	3.52	0.36	0.85	0.99	0.99	1.13	1.26	1.38	2.34	1.64	0.68	0.90	1.01
LSD(0.01)	1.54	2.59	4.74	0.48	1.15	1.34	1.34	1.52	1.69	1.85	3.15	2.21	0.91	1.22	1.35
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**	**	**	**
CV (%)	6.65	3.75	3.66	5.50	5.20	3.72	6.51	5.14	4.64	6.33	8.09	4.75	7.54	7.37	7.26

* = Significant at 5% level of probability

** = Significant at 1% level of probability

4.5 Petiole length

Different levels of cowdung showed significant influence on petiole length at 15, 30 and 45 DAS. At 15 DAS, the longest petiole length (7.38 cm) was recorded from C_3 where as the shortest length (3.37 cm) was found from control treatment. At 30 DAS, the longest petiole length (10.25 cm) was recorded from C_3 while the shortest length (4.62 cm) was obtained from control treatment. At 45 DAS, the longest length (11.29 cm) was obtained from C_3 and the shortest length (5.66 cm) was found from control treatment (Table 1).

Poultry litter showed significant influence on petiole length of okra at 15, 30 and 45 DAS. At 15 DAS, the longest petiole length (6.22 cm) was recorded from P_3 where as the shortest length (4.82 cm) was obtained from control treatment. At 30 DAS, the longest petiole length (8.02 cm) was found from P_3 and the shortest length (7.06 cm) was recorded from control treatment. At 45 DAS, the longest length (9.25 cm) was found from P_3 while the lowest length (8.05 cm) was obtained from control treatment (Table 2).

Combined effect of cowdung and poultry litter showed significant variation on length of petiole of okra plant at different days after sowing. At 15 DAS, the highest length (8.63 cm) was recorded from C_3P_3 where as the lowest length (3.08 cm) was found from control treatment. At 30 DAS, the highest length (11.20 cm) was recorded from C_3P_3 while the lowest length (4.67 cm) was obtained from control treatment. At 45 DAS, the highest length (11.61 cm) was obtained from C_3P_3 where as the lowest length (5.46 cm) was found from control treatment (Table 3).

4.6 Green pod length

Cowdung showed significant influence and C_3 produced maximum green pod length (14.05 cm) which was statistically similar to C_2, C_1. and control treatment produced minimum pod length (12.78 cm) (Table 4).

Different levels of poultry litter showed significant influence on pod length (Table 5). P_3 produced the maximum pod length (13.88 cm) which was statistically similar to P_2, P_1. and control treatment produced the minimum pod length (12.99 cm).

Significant variation of green pod length was observed with the interaction of cowdung and poultry litter. The maximum pod length (14.36 cm) was recorded from C_3P_3 treatment where as minimum pod length (12.72 cm) was obtained from control treatment (Table 6). The result revealed significant influence on pod size and same trend of result was reported by Palevich (1965), Prezotti *et al.*(1988).

4.7 Green pod diameter

Cowdung showed significant influence on pod diameter and the maximum pod diameter (1.90 cm) was obtained from C_3 which was statistically similar to C_2, C_1 while the minimum pod diameter (1.78 cm) was obtained from control treatment (Table 4).

Poultry litter showed significant influence on pod breadth (Table 5). P_3 produced the maximum pod diameter (1.92 cm) which was statistically similar to P_2, P_1 and control treatment produced the minimum pod diameter (1.79 cm).

Green pod diameter varied significantly due to combined effect of cowdung and poultry litter. The interaction of C_3P_3 produced the maximum green pod diameter (1.96 cm) and control treatment produced the minimum pod diameter (1.78 cm) (Table 6). The result revealed that manure improved pod size which was similar trend to the result observed by Palevich (1965).

4.8 Number of pods plant^{-1}

Analysis of variance showed that the effect of cowdung on the number of green pod was highly significant. Among the treatments of cowdung, the maximum number of green pod (15.39) was obtained from C_3 and the minimum number of pod (11.97) was found from control treatment (Table 4).

Poultry litter showed highly significant influence on the number of pod. The maximum number of pod (14.70) was recorded from P_3 where as the minimum number of pod (12.7) was obtained from control treatment (Table 5).

The analysis of variance also revealed that the number of green pod per plant varied significantly due to the combined effect of cowdung and poultry litter. The maximum number of green pod (16.25) was obtained from C_3P_3 and the minimum number of green pod (11.05) was found from control treatment (Table 6).

4.9 Individual pod weight

Cowdung showed significant influence on individual pod weight. The maximum pod weight (16.09 g) was found from C_3 and the minimum pod weight (13.78 g) was obtained from control treatment (Table 4).

From poultry litter, significant influence on individual pod weight was found. The maximum individual pod weight (15.57 g) was obtained from P_3 and the minimum pod weight (14.34 g) was recorded from control treatment (Table 5).

The combination of cowdung and poultry litter showed highly significant influence on individual pod weight. The lowest pod weight (13.54 g) was obtained from control treatment where as the maximum pod weight (16.60 g) was obtained from C_3P_3 and C_3P_2, C_3P_1 were statistically similar (Table 6). The result revealed that cowdung and poultry litter in combination increased weight per fruit. Similar results were found by Palevich (1965).

4.10 Pod yield plant^{-1}

Cowdung showed highly significant variation on green pod yield per plant. The maximum green pod yield per plant (247.91 g) was recorded from C_3 and the minimum green pod yield per plant (165 g) was recorded from control treatment (Table 4).

Poultry litter showed significant variation on green pod yield and P_3 produced the maximum pod yield per plant (218.68 g) where as control treatment gave the minimum pod yield per plant (181.87 g) (Table 5).

From the analysis of varience, it was found that combined effect of cowdung and poultry litter performed significantly on green pod yield per plant. The maximum pod yield per plant (269.72 g) was obtained from C_3P_3 and the minimum pod yield per plant (149.72 g) was obtained from control treatment (Table 6). The result revealed that manure showed beneficial effect on yield which was similar with the observation in the experiment carried out by Rue (1998).

4.11 Pod yield plot^{-1}

From the analysis of varience, it was found that the effect of cowdung on the yield per plot was highly significant.C_3 showed the highest yield (2.98 kg) and control treatment gave the lowest yield per plot (1.98 kg) (Table 4). Same trend was found by Palevich (1965).

Poultry litter showed highly significant influence on the yield per plot though the yield per plot from different level of Poultry litter was statistically similar. P_3 gave the highest yield per plot (2.62 kg) and control treatment gave the lowest yield per plot (2.18 kg) (Table 5). Same trend was reported by Dumitrescu (1960), Farid *et al.* (1998).

Combined use of cowdung and poultry litter at different doses showed highly significant influence on the yield per plot.C_3P_3 gave the highest yield per plot (3.24 kg) where as control treatment gave the lowest yield per plot (1.80 kg) (Table 6). This result might be due to organic manure increase nutrient content and productivity as suggested by Prezotti *et al.* (1988).

4.12 Pod yield hectare^{-1}

Cowdung showed highly significant influence on the green pod yield per hectare. The maximum green pod yield per hectare (8.30 ton) was recorded from C_3 where as the lowest pod yield (5.51 ton) was obtained from control treatment (Figure 6). The result showed that cowdung application significantly increase yield as reported by Palevich (1965).

Poultry litter showed significant influence on the pod yield per hectare. The maximum yield (7.30 ton) was found from P_3 and the minimum yield (6.18 ton) was obtained from control treatment (Figure 7). Hochmuth *et al.* (1993) reported that the yield responded quadratically to increasing rate of poultry manure.

Analysis of variance revealed that the combined effect of cowdung and poultry litter on the pod yield per hectare was highly significant. The maximum pod yield (9 ton/ha) was recorded from C_3P_3 where as the minimum pod yield (5 ton/ha) was obtained from control treatment (Figure 8). The result showed significant increase in yield with increase in manure and the same trend was reported by Ferreira *et al.* (2002).

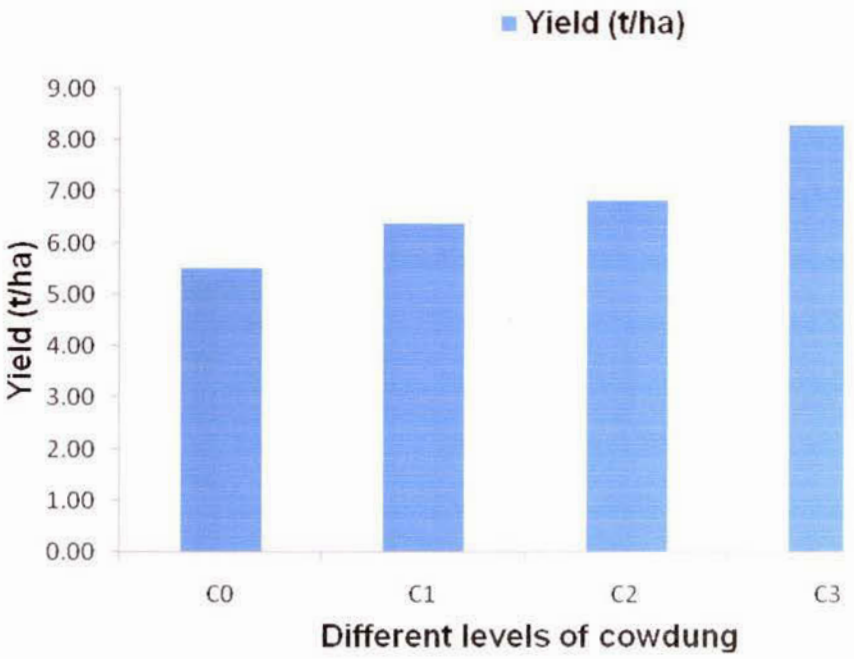


Figure 6. Effect of different levels of cowdung on the yield of okra

C_0 = 0 t/ha, C_1 = 9 t/ha, C_2 = 10 t/ha, C_3 = 11 t/ha

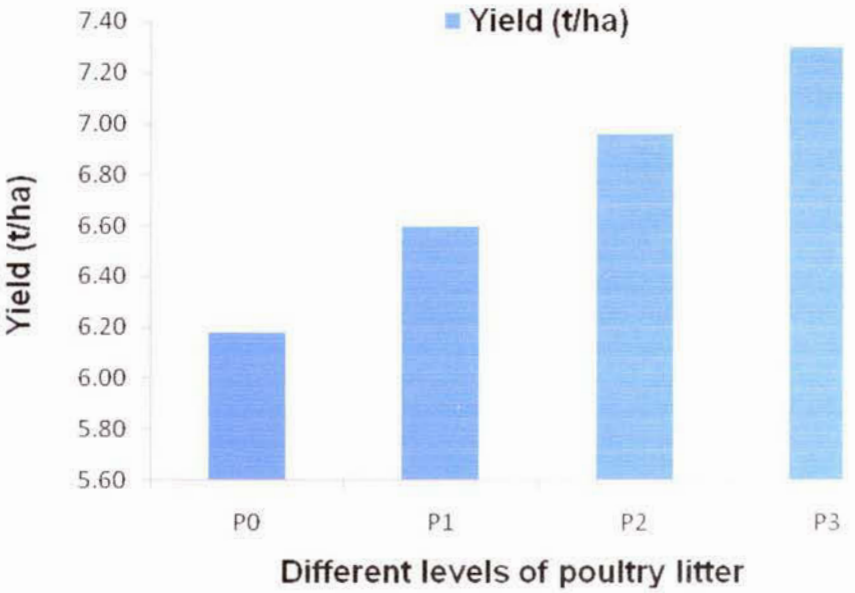


Figure 7. Effect of different levels of poultry litter on the yield of okra

P_0 = 0 t/ha, P_1 = 7 t/ha, P_2 = 8 t/ha, P_3 = 9 t/ha

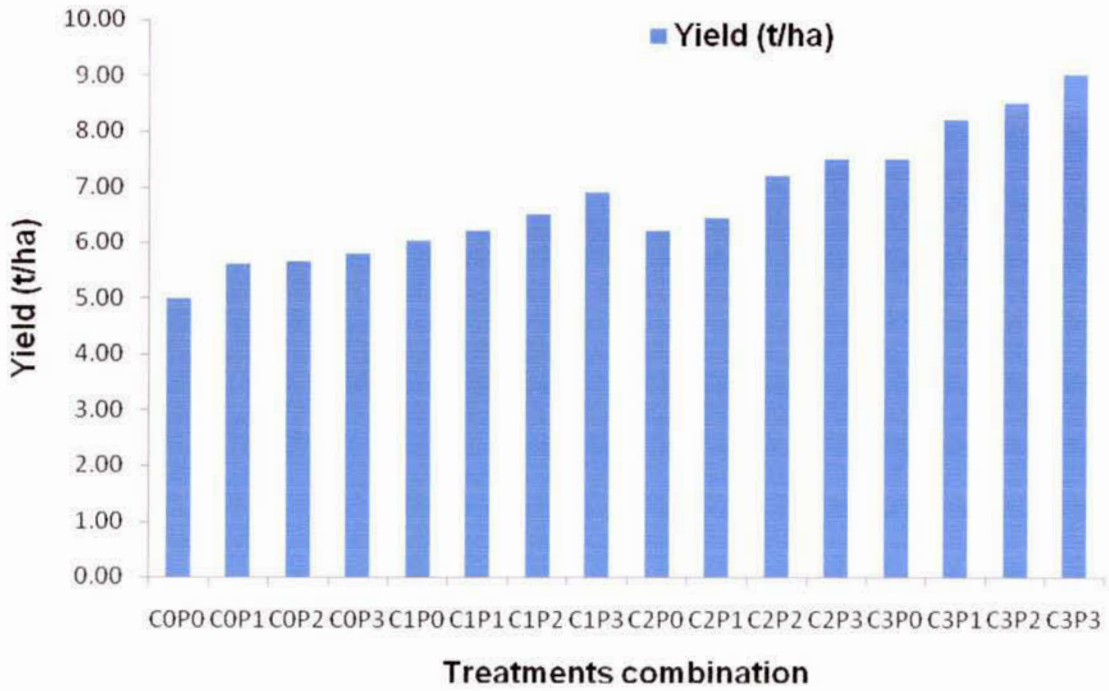


Figure 8. Effect of the combination of different levels of cowdung and poultry litter on the yield of okra

C_0 = 0 t/ha, C_1 = 9 t/ha, C_2 = 10 t/ha, C_3 = 11 t/ha

P_0 = 0 t/ha, P_1 = 7 t/ha, P_2 = 8 t/ha, P_3 = 9 t/ha

Table 4: Effect of Cowdung on pod length, pod diameter, pod weight, number of pod per plant, yield per plant and yield per plot.

Treatment	Pod length(cm)	Pod diameter	Pod weight	No. of Pod plant^{-1}	Yield Plant^{-1} (g)	Yield Plot^{-1} (kg)
C_0	12.78	1.78	13.78	11.97	165.00	1.98
C_1	13.07	1.80	14.99	12.62	189.44	2.27
C_2	13.75	1.83	15.73	13.06	204.65	2.46
C_3	14.05	1.90	16.09	15.39	247.91	2.98
LSD(0.05)	0.86	0.11	0.86	1.48	25.72	0.31
LSD(0.01)	1.16	0.14	1.17	1.99	34.64	0.41
Level of significance	**	*	**	**	**	**
CV (%)	3.85	3.62	3.43	6.68	7.65	7.65

NS = Not Significant
* = Significant at 5% level of probability
** = Significant at 1% level of probability

Table 5: Effect of Poultry litter on pod length, pod diameter, pod weight, number of pod per plant, Yield per plant and yield per plot.

Treatment	Pod length (cm)	Pod diameter	Pod weight	No. of Pod plant^{-1}	Yield Plant^{-1} (g)	Yield Plot^{-1} (kg)
P_0	12.99	1.79	14.34	12.7	181.87	2.18
P_1	13.43	1.82	15.28	13.43	197.84	2.37
P_2	13.56	1.86	15.42	13.9	208.60	2.50
P_3	13.88	1.92	15.57	14.70	218.68	2.62
LSD(0.05)	0.86	0.11	0.86	1.48	25.72	0.31
LSD(0.01)	1.16	0.14	1.17	1.99	34.64	0.41
Level of significance	*	*	**	**	**	**
CV (%)	3.85	3.62	3.43	6.68	7.65	7.65

NS = Not Significant
* = Significant at 5% level of probability
** = Significant at 1% level of probability

Table 6: Combined effect of Cowdung and Poultry litter on yield and yield contributing characters of okra

Treatment	Pod length (cm)	Pod diameter	Pod weight	No of Pod plant^{-1}	Yield Plant^{-1} (g)	Yield Plot^{-1} (kg)
C_0P_0	12.72	1.78	13.54	11.05	149.72	1.80
C_0P_1	12.75	1.78	13.68	12.24	167.50	2.01
C_0P_2	12.78	1.78	13.88	12.21	169.16	2.03
C_0P_3	12.85	1.79	14.02	12.38	173.60	2.08
C_1P_0	12.90	1.79	14.25	11.96	170.55	2.04
C_1P_1	13.05	1.80	15.09	12.3	185.55	2.23
C_1P_2	13.10	1.81	15.20	12.83	195.00	2.34
C_1P_3	13.25	1.82	15.45	13.38	206.66	2.48
C_2P_0	13.08	1.79	14.79	12.81	185.55	2.23
C_2P_1	13.65	1.81	15.85	12.16	192.77	2.31
C_2P_2	14.05	1.84	16.08	13.4	215.55	2.59
C_2P_3	14.20	1.88	16.20	13.87	224.72	2.70
C_3P_0	13.27	1.80	14.78	15	221.66	2.66
C_3P_1	14.26	1.90	16.48	14.89	245.55	2.95
C_3P_2	14.30	1.92	16.52	15.41	254.72	3.06
C_3P_3	14.36	1.96	16.60	16.25	269.72	3.24
LSD(0.05)	0.86	0.11	0.86	1.48	25.72	0.31
LSD(0.01)	1.16	0.14	1.17	1.99	34.64	0.41
Level of significance	**	**	**	**	**	**
CV (%)	3.85	3.62	3.43	6.68	7.65	7.65

* = Significant at 5% level of probability
** = Significant at 1% level of probability

CHAPTER V

SUMMARY AND CONCLUSION

The experiment was conducted at the central farm of Sher-e-Bangla Agricultural University during the period of April to July,2007. The experiment was carried out to evaluate the effect of different levels of cowdung and poultry litter on the growth and yield of okra. The experiment consists of two factors such as four levels of cowdung viz, 0, 9, 10 and 11 t/ha and four levels of poultry litter viz, 0, 7, 8 and 9 t/ha. Two factors experiment was laid out in Randomized Complete Block Design (RCBD) with three replications.

Application of cowdung exhibited a significant influence on plant height at 15, 30 and 45 DAS. At 15 DAS, the tallest plant (14.66 cm) was found in the highest dose of cowdung application C_3 and the shortest (6.46 cm) plant in C_0. At 30 DAS, the highest plant height (41.99 cm) was obtained from C_3 and the lowest plant height (19.28 cm) was obtained from C_0. At 45 DAS, the tallest plants (71.66 cm) were obtained from C_3 and the shortest (40.72 cm) were obtained from C_0.

Application of poultry litter exhibited a significant influence on plant height at 15, 30 and 45 DAS. At 15 DAS, P_3 produced the highest plant height (11.35 cm) and the lowest plant height (9.26 cm) was found in P_0. At 30 DAS, the highest plant height (34.55 cm) was recorded from P_3 and the lowest (27.05 cm) was recorded from P_0. At 45 DAS, the highest height (61.73 cm) was recorded from P_3 and the lowest (53.58 cm) was recorded from P_0.

The treatment combinations at 15, 30 and 45 DAS significantly influenced the plant height. At 15 DAS, the highest plant height (15.67 cm) was observed in C_3P_3 and the lowest (6.47 cm) in C_0P_0. At 30 DAS, the highest plant height

(47.46 cm) was observed in C_3P_3 and the lowest (16.68 cm) in C_0P_0. At 45 DAS, the highest plant height (76.88 cm) was observed in C_3P_3 and the lowest (37.38 cm) in C_0P_0.

The number of leaves of okra plant was significantly influenced by cowdung at 15, 30 and 45 DAS. At 15 DAS, the maximum leaves/plant (4.41) was found from C_3 and the minimum (3.24) was found from C_0. At 30 DAS, the maximum leaves/plant (10.94) was found from C_3 and the minimum (8.66) was found from C_0. At 45 DAS, the maximum leaves/plant (17.71) was found from C_3 and the minimum (14.09) was found from C_0.

Marked variation was found in different levels of poultry litter application in respect of number of leaves/plant at 15, 30 and 45 DAS. At 15 DAS, the maximum leaves/plant (4.08) was found in P_3 and the minimum (3.69) was found in P_0. At 30 DAS, the maximum leaves/plant (10.13) was found in P_3 and the minimum (9.51) was found in P_0. At 45 DAS, the maximum leaves/plant (16.54) was found in P_3 and the minimum (15.24) was found in P_0.

Significant variation was found among the treatment combination of cowdung and poultry litter at 15, 30 and 45 DAS. At 15 DAS, the maximum leaves/plant (4.83) was found from C_3P_3 and the minimum (3.01) was recorded from C_0P_0. At 30 DAS, the maximum leaves/plant (11.53) was found in C_3P_3 and the minimum (8.16) was found in C_0P_0. At 45 DAS, the maximum leaves/plant (18.16) was found in C_3P_3 and the minimum (12.63) was found in C_0P_0.

Cowdung exhibited a significant influence on leaf length at 15, 30 and 45 DAS. At 15 DAS, the highest leaf length (11.29 cm) was found from C_3 and the lowest (6.30 cm) recorded from C_0. At 30 DAS, the highest length (16.25 cm) was obtained from C_3 and the lowest (9.48 cm) was obtained from C_0. At 45

DAS, the highest leaf length (18.70 cm) was obtained from C_3 and the lowest (12.74 cm) from C_0.

Poultry litter exhibited a significant influence on leaf length at 15, 30 and 45 DAS. At 15 DAS, P_3 produced the maximum leaf length (9.83 cm) and the minimum (8.50 cm) was found in P_0. At 30 DAS, the maximum leaf length (14.13 cm) was recorded from P_3 and the minimum (12.20 cm) was recorded from P_0. At 45 DAS, the maximum length (17.14 cm) was recorded from P_3 and the lowest (15.39 cm) was recorded from P_0.

The treatment combination of cowdung and poultry litter showed significant influence on leaf length at 15, 30 and 45 DAS. At 15 DAS, the maximum leaf length (12.21 cm) was observed in C_3P_3 and the minimum (5.65 cm) was recorded from C_0P_0. At 30 DAS, the maximum leaf length (16.95 cm) was observed in C_3P_3 and the minimum (8.46 cm) was found in C_0P_0. At 45 DAS, the maximum leaf length (19.52 cm) was observed in C_3P_3 and the minimum was (11.61 cm) found from C_0P_0.

Cowdung influenced leaf breadth significantly. At 15 DAS, the maximum breadth (16.11cm) was found from C_3 and the minimum (9.18 cm) observed in C_0. At 30 DAS, the maximum breadth (22.03 cm) was obtained from C_3 and the minimum (11.90cm) was recorded from C_0. At 45 DAS, the maximum breadth (25.54 cm) was obtained from C_3 and the minimum (15.47cm) was found from C_0.

At 15 DAS, P_3 produced the maximum (14 cm) leaf breadth and the minimum (12.15 cm) was found in P_0. At 30 DAS, the maximum breadth (18.84 cm) was recorded from P_3 and the minimum (15.95 cm) was obtained from P_0. At 45

DAS, the maximum breadth (22.13 cm) was obtained from P_3 and the minimum (19.49 cm) was recorded from P_0.

Combined application showed significant effect on leaf breadth. At 15 DAS, the maximum (17.13 cm) was observed in C_3P_3 and the minimum (8.15 cm) observed in C_0P_0. At 30 DAS, the maximum (23.39 cm) was observed in C_3P_3 and the minimum (10.38 cm) recorded from C_0P_0. At 45 DAS, the maximum (26.48 cm) was observed in C_3P_3 and the minimum (14.23 cm) in C_0P_0.

Cowdung showed significant influence on petiole length. At 15 DAS, the highest length (7.38 cm) was found from C_3 and the lowest (3.37 cm) in C_0. At 30 DAS, the highest length (10.25 cm) was found from C_3 and the lowest (4.62cm) was obtained from C_0. At 45 DAS, the highest length (11.29 cm) was obtained from C_3 and the lowest (5.66 cm) from C_0.

At 15 DAS, P_3 produced the maximum petiole length (6.22 cm) and the minimum (4.82 cm) was found in P_0. At 30 DAS, the maximum length (8.02 cm) was recorded from P_3 and the minimum (7.06 cm) was recorded from P_0. At 45 DAS, the maximum length (9.25 cm) was recorded from P_3 and the lowest (8.05 cm) was recorded from P_0.

Combined effect of cowdung and poultry litter showed significant effect on petiole length. At 15 DAS, the maximum petiole length (8.63 cm) was observed in C_3P_3 and the minimum (3.08 cm) in C_0P_0. At 30 DAS, the maximum length (11.20 cm) was observed in C_3P_3 and the minimum (4.67 cm) in C_0P_0. At 45 DAS, the maximum length (11.61 cm) was observed in C_3P_3 and the minimum (5.46 cm) in C_0P_0.

Cowdung showed significant effect on pod length. C_3 produced the maximum length (14.05 cm) and the minimum (12.78 cm) from C_0. Poultry litter showed significant influence on pod length and P_3 produced the maximum length (13.88 cm) while P_0 gave the minimum length (12.99 cm). In combination the maximum pod length (14.36 cm) was obtained from C_3P_3 and the minimum (12.72 cm) found from C_0P_0.

C_3 produced the maximum pod diameter (1.90 cm) and the minimum (1.78 cm) from C_0. P_3 produced the maximum pod diameter (1.92 cm) while P_0 gave the minimum (1.79 cm). In combination the maximum pod diameter (1.96 cm) was obtained from C_3P_3 and the minimum (1.78 cm) from C_0P_0.

C_3 produced the maximum number of pod/plot (15.39) and the minimum (11.97) from C_0. P_3 produced the maximum number of pod/plot (14.70) while P_0 gave the minimum (12.7). In combination the maximum number of pod/plot (16.25) was obtained from C_3P_3 and the minimum (11.05) found from C_0P_0.

Cowdung significantly influenced individual pod weight. The maximum weight (16.09 gm) was found in C_3 while the minimum (13.78 gm) in C_0. Poultry litter showed the same effect and P_3 gave the maximum weight (15.57 gm) where as P_0 gave the minimum (14.34 gm). In combination, C_3P_3 gave the maximum (16.60 gm) result and C_0P_0 gave the minimum (13.54 gm) result.

The pod yield/plant was significantly influenced by cowdung. C_3 gave the maximum yield (247.91 gm) and C_0 gave the minimum (165 gm). Poultry litter influenced significantly the pod yield/plant and P_3 gave the maximum yield (218.68gm) and P_0 gave the minimum (181.87 gm). Among the treatments combination, C_3P_3 gave the maximum yield (269.72 gm) and C_0P_0 gave the minimum (149.72 gm).

Application of cowdung performed significantly in respect of pod yield/plot and C_3 gave the highest yield (2.98 kg) and C_0 gave the lowest (1.98 kg). Poultry litter showed significant influence on the pod yield/plot and P_3 gave the highest yield (2.62 kg) and P_0 gave the lowest (2.18 kg). Among the treatment combination, C_3P_3 gave the highest yield (3.24 kg) and C_0P_0 gave the lowest (1.80 kg).

Application of cowdung exhibited significant influence on yield/ha of okra plants. The maximum yield (8.30 t/ha) was recorded from C_3 while the minimum (5.51t/ha) was observed in C_0. Application of poultry litter exhibited significant influence on yield/ha of okra plants. The maximum yield (7.30 t/ha) was recorded from P_3 while the minimum (6.18 t/ha) was found in P_0. The treatment combination significantly influenced yield per hectare. The maximum yield per hectare (9.0 t/ha) was recorded from C_3P_3 while the minimum (5.0 t/ha) was recorded from C_0P_0.

Considering the study, the following conclusion could be drawn:

(1) Cowdung and poultry litter had significant influence on growth and yield of okra and C_3P_3 (11 ton cowdung/ha and 9 ton poultry litter/ha) gave the highest yield.

(2) The present study was conducted in an individual soil type and further regional trials should be needed to evaluate other organic manures as source of nutrients for better growth and yield of okra.

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APPENDICES

Appendix I: Monthly record of air temperature, rainfall, relative humidity and sunshine hours during the study period.

(April, 2007 to July, 2007)

Year	Month	Average air temperature (^{O}C)			Total rainfall (mm)	Average relative humidity (%)	Average sunshine hours/day
		Maximum	Minimum	Mean			
2007	April	33.6	23.6	28.6	163	69	6.8
	May	34.7	25.9	30.3	185	70	7.8
	June	32.4	25.5	28.95	628	81	4.7
	July	31.4	25.7	28.55	753	84	3.3

Source: The Meteorological Department (Weather Division) of Bangladesh, Agargaon, Dhaka.

Appendix II: A. Morphological characteristics of soil in the experimental field

Morphological features	**Characteristics**
Location	Central Farm, SAU, Dhaka
AEZ	Madhupur Tract (28)
General Soil Type	Shallow red brown terrace soil
Land type	High land
Soil series	Tejgaon
Topography	Fairly leveled
Flood level	Above flood level
Drainage	Well drained
Cropping pattern	Okra

Source: SRDI, Farmgate, Dhaka

B. Physical and chemical properties of the initial soil

Characteristics	Value
% Sand	27
% Silt	43
% Clay	30
Textural Class	Silty - Clay
P^H	5.6
Organic carbon (%)	0.45
Organic matter (%)	0.78
Total N (%)	0.03
Available P (ppm)	20.00
Exchangeable K (me/100 g soil)	0.10
Available S (ppm)	45

Source: SRDI, Farmgate, Dhaka

Appendix III: Analysis of variance of the data on plant height, number of leaves, leaf length, leaf breadth and petiole length of Okra

Source of Varience	Degrees of freedom (df)	Mean Sum of Square														
		Plant height (cm.)			No. of leaves			Leaf length (cm.)			Leaf breadth (cm.)			Petiole length (cm.)		
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS
Replication	2	0.6	6.49	35.48	0.13	0.43	1.23	15.87	3.32	43.45	50.29	5.77	21.3	3.52	0.24	0.38
Factor A	3	442.19**	3674.25**	6737.23**	8.5**	34.02**	85.63**	165.68**	308.43**	240.37**	323.18**	683.91**	687.96**	114.6**	206.64**	205.57**
Factor B	3	27.50**	366.51**	420.58**	0.95**	2.38**	11.66**	11.24*	24.12**	19.7*	21.7*	55.31*	46.43**	12.68**	8.00*	10.43*
AB	9	7.38**	72.5**	34.64**	0.58**	2.22**	4.62**	0.94**	1.85**	2.12**	2.40**	9.04**	8.91**	4.83**	7.34**	5.56**
Error	30	14.1	39.75	133.43	1.37	7.82	10.61	10.64	13.77	16.98	20.46	59.06	29.07	4.95	8.82	10.89

Appendix IV: Analysis of varience of the data on number of pod plant^{-1}, pod length, pod diameter, pod weight, yield plant^{1}, yield plot^{-1} and yield hectare^{-1} of Okra

Source of Varience	Degrees of freedom (df)	Mean Sum of Square						
		No of Pod plant^{-1}	Pod length (cm)	Pod diameter (cm)	Pod weight (g)	Yield Plant^{-1} (g)	Yield Plot^{-1} (kg)	Yield ha^{-1} (t)
Replication	2	1.27	0.1	0.03	0.36	1146.74	0.17	0.94
Factor A	3	79.72**	12.41**	0.09*	37.57**	43702.05**	6.29**	48.68**
Factor B	3	11.81**	3.14*	0.03*	11.01**	8927.57**	1.29**	8.26**
AB	9	3.46**	1.77**	0.02**	2.48**	895.63**	0.13**	1.21**
Error	30	23.52	7.98	0.13	8.08	7138.35	1.02	8.08